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Protein and Amino Acid Profile of Meals in Habitual Diets of Young Indian Women

Renuka Aggarwal and Kiran Bains

Dept. of Food and Nutrition, Punjab Agricultural University, Ludhiana, Punjab (141 027), India

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Corresponding renukaaggarwal@pau.edu

0000-0002-8646-8792

ABSTRACT

The study was carried out among thirty young adult women (21–30 years) residing in hostels of Punjab Agricultural University, Ludhiana, Punjab during January, 2020 to assess the quantity and quality of protein in hostel diets. The duplicate meals in the daily diet of thirty institutionalized 21–30 years old young adult women were collected for seven consecutive days and analyzed for protein and amino acid content. The diets served on different days of the week were low in protein and lysine in all the meals but had adequate amount of other Indispensable Amino Acids (IAA). The three meals (breakfast, lunch and dinner) had low *in vitro* protein digestibility varying from 69.18% to 81.84% and a low Protein Digestibility-Corrected Amino Acid Score (PDCAAS) of 0.39, 0.46 and 0.39. On comparing the protein quality of three major meals of the diet, we found that all meals had a lower protein and lysine content with adequate amount of other IAAs. The overall digestibility of three meals was 74.58% with a PDCAAS of 0.42. The results indicated that diets of the young women living in hostels was low in protein quantity and quality especially in terms of amino acid lysine which is required for healthy body composition with higher muscle content. The quality protein deficiency in youth can affect muscle mass which can adversely affect the health thereby, leading to a rise in different types of diseases at later age.

KEYWORDS: Body composition, hostel diets, indispensible amino acids, lysine, protein

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1. INTRODUCTION

According to Anonymous (2018), the Non-communicable Diseases (NCDs) are on the rise and kill 41 million people each year, equivalent to 71% of all deaths globally. The literature reports that abnormal body composition having more of fat mass is the main cause. Maintaining an optimum body composition with lesser fat mass and more of muscle mass can be one slant to overcome the burden of NCDs. Muscles play a significant role in obesity. Resting Energy Expenditure is significantly affected by muscle protein turnover which is stimulated as a result of substantially maintained muscle mass (Paddon *et al* 2004). Fat oxidation is the main source of energy for muscle protein turnover leading to maintained energy balance and thus helps to prevent obesity (Rasmussen and Wolfe 1999). The proportional reduction of muscles represents higher percentage of fat mass leading to higher amounts of plasma Free Fatty Acids (FFA). Greater amounts of plasma FFA is linked to insulin resistance and inhibit glucose oxidation and limit glucose uptake in the muscles. Therefore, insulin resistance is found to be associated with triacylglycerol deposition in muscles (Goodpaster *et al* 2003). Dietary proteins influence factor IGF-1 which has a positive effect on bone formation and skeletal development and plays a critical role similar to that of calcium and vitamin D in the prevention of osteoporosis and maintaining bone health (Schurch *et al* 1998). Muscle contractions, body weight and weight-bearing exercises are the major sources of mechanical force on bones (Frost 1997). Protein intake in the diet directly affects muscle mass as higher amounts of dietary protein leads to greater availability of plasma amino acids resulting in an increased protein synthesis (Motil *et al* 1981). Optimum muscle mass can be maintained by taking high protein quality diets and this way many chronic diseases and pathological conditions can be prevented. Intake of Indispensable amino acids (IAA) stimulates the synthesis of muscle proteins in the same way as it is stimulated by a combination of IAA and other Dispensable amino acids (Wolfe et al., 2016)

Laplante and Sabatini (2012) reported that during the deficiency of specific amino acids mammalian target of rapamycin complex 1 (mTORC1) perceives it as amino acid deficiency and suppresses cellular growth, protein and lipid synthesis. To meet the nutritional demands at the global level the quantity and quality of proteins should be sufficient and the diet must provide a balanced supply of essential amino acids (Wolfe et al., 2016). Cereals are limiting in lysine while sulphur containing amino acids are limiting in pulses. Rutherfold et al. (2012) determined true ileal digestibility of most amino acids including for eleven foods and ten food ingredients commonly consumed in India and observed that amino acid digestibility was low for majority of the prepared foods and ingredients and recommended that digestibility should be considered when estimating the quality of protein for poor quality foods. Cereal based Indian diets provide 60% of poor quality protein with low digestibility (Swaminathan et al., 2012). Almost 50–60% of protein intake in India is through cereals. Pulses provide10and 11% of protein intake, while milk and other dairy products contribute 10 and 12% in rural and urban Indian diets, respectively (Anonymous, 2014). The provisional data of Ministry of Agriculture (2016) revealed a lower per capita net availability of pulses to the tune of 47.2 g day^{-1} in India. Furthermore, negligible lysine intakes in low socio-economic group Indians need attention as they are much lower than the daily recommended lysine intake of 45 mg g^{-1} protein for healthy adults (Anonymous, 2013). Minocha et al. *(*2017) reported that 4–26% population of various age groups belonging to rural or urban sectorsis at risk of quality protein deficiency.

To fulfill the minimum amount of lysine from cereals, the required total protein intake should be higher than the daily recommended intake. Out of the total consumption of protein throughout the world, 60% is dependent on plant-based protein while animal protein contributes to only 40% of the total protein intake (Boland et al., 2013, Anonymous, 2018). Animal protein sources like milk and egg which are rich in quality protein and may possess positive effect on bone turnover (Miranda et al., 2015).

Grewal et al. (2020) and Aggarwal et al. (2022) demonstrated that in populations having limited resources, more consumption of cereals and lesser amount of animal foods give low quality dietary protein that has a negative effect on muscle mass. So, to appraise the overall diet quality and nutritional status of any population, it is pertinent to evaluate the nutrient composition of different meals of the daily diets. The present study was undertaken to investigate the protein quantity and quality of the diets being served in a hostel mess to young adult women.

2. MATERIALS AND METHODS

The study was carried out among thirty young adult women (21–30 years) residing in hostels of Punjab Agricultural University, Ludhiana, Punjab with a latitude of 30° 54’ N and longitude 75° 48’ E. Information regarding weekly set menu was collected from the hostel mess in January 2020. The breakfast usually comprised of a cereal preparation and was served with curd or butter whereas lunch had a combination of one legume with vegetable served with cereals (*chapati* or *roti*) and curd. The meal in the dinner consisted of one serving of pulse supplemented with cereal and accompanied by either curd or a sweet dish (Table 1).

Table 1: Weekly Menu of the selected hostel meals

Day	Breakfast	Lunch	Dinner
Monday	Cottage cheese *parantha**+curd/butter	chickpea+rice+*chapati***+curd	Potato +Mungbean (dehusked and split)+fried rice+*chapati***+Banana/curd
Tuesday	*AlooParantha**+curd/ butter	Kidney beans+rice+chapati**+curd	Mixed vegetable+Lentils)+rice+*chapati* **+curd
Wednesday	Chickpea+*parantha**	*Karhi*+soya nuggets+rice+*chapati***	Cheese tomato/chicken+rice+*chapati*+*Boondiladoo*****/curd
Thursday	Stuffed cauliflower *parantha**+curd i/ butter	Mashbean++rice+*chapati***+curd	Peas-mushroom+Mungbeans+rice+*chapati*+*jalebi*****/curd
Friday	Stuffed fenugreek leaves *parantha**+curd/ butter	Vegetable dumplings in curry++rice+*chapati***+curd	Potato-capsicum+Mungbean and chickpea *chapati*+kheer****/curd
Saturday	2 Potato cutlet+2 eggs (boiled/omelette)	Potato-peas+rice+*chapati***+curd	Brinjal+Mashbean+rice+*chapati*+*gulabjamun*****/curd
Sunday	Stuffed legume *parantha*+curd/butter/ boiled egg	Grams+*Bhatura****+rice+curd	Potato-cauliflower+Lentils+*chapati*+*seviyan*****/curd

*Parantha: Native flat bread with oil and butter; **Chapati: unleavened flat bread; ***Bhatura: deep-fried leavened bread; ****: BoondiLadoo, jalebi, gulabjamun, kheer and sevian are sweet preparations prepared from chickpea flour, refined wheat flour, rice, milk, sugar and oil/clarified butter

The duplicate meals served in the daily diets to the subjects in their hostel mess were collected for a period of seven consecutive days. All the food preparations consumed in a meal were homogenized to form one composite meal. Three composite meals of the day were breakfast, lunch and dinner. Therefore, twenty-one composite meals consumed during a week i.e. from Monday to Sunday by each subject were collected and dried in the hot air oven at 60°C till constant weight to determine the moisture content in fresh samples.

The dried samples were powdered and stored in air tight plastic bags. The dried food samples were analyzed for crude protein by methods of Anonymous (2005).The composite meals were estimated for their essential amino acid content using GC-MS (GC-MS/MS Triple Quad, Agilent-GC 7890A and MS 7000)in which the amino acids were first extracted from the sample followed by its deproteinization and derivatization. . The *in vitro* Protein Digestibility (IVPD) of the composite meal was assessed by method of Akeson et al. (1964).Protein digestibility corrected amino acid score (PDCAAS)was calculated using the formula given by Anonymous (1991):

PDCAAS =(mg of limiting amino acid in 1 g of test protein/ mg of same amino acid in 1 g reference protein) ×*In vitro* protein digestibility

Where (i) Amino acid lysine was considered as the most limiting amino acid in the composite meals.

(ii) Reference amino acid pattern was taken as the amino acid requirement of preschool children of 2–5 years of age.

(iii)Values greater than 1.00 were truncated to 1.00.

The data was statistically analyzed using SPSS software. Mean and standard deviations for various parameters were computed. Analysis of Variance (One-way ANOVA) and post hoc test was employed to assess the difference of nutrients eaten in different meals.

3. RESULTS AND DISCUSSION

Diet is a major determinant of health status and is the sum of meals that an individual consumes throughout the day while a meal is the sum of different foods eaten together at one time. Foods, however, are complex combinations of nutrients and other compounds that act synergistically within the food and across food combinations. So, to appraise the overall diet quality and nutritional status of any population, it is pertinent to evaluate the nutrient composition of different meals of the daily diets. The quantity and quality of protein of seven days menu of hostel diets have been presented in the tables 2 to4. The moisture content of the composite meals varied in a wider range with least average moisture content in breakfast (65.77%) followed by dinner (69.80%) and lunch (71.99%). The crude protein content of composite meals served in breakfast during different weekdays ranged from 22.70 to 35.65 g 100 g^{-1} with a mean value of 28.41 g 100 g^{-1} on dry matter basis (Table 2). A significant ($p \leq 0.05$) difference in protein content of breakfast meals served on different days was observed. The data revealed that the meals served on Day-7 had maximum protein content followed by breakfast meals of Day-5 and Day-6. Similarly, the lunch and dinner served on Day-7 had maximum protein (36.75 and 29.55 g, respectively) which was mainly due to variation of foods in the prescribed menu of a particular day.

The quality of protein is a function of its Indispensable amino acid (IAA) content and its digestibility. A narrow variation in the lysine content of breakfast meals was found with the lysine content ranging from 883 to 950 mg 100 g^{-1} DM with maximum lysine content in the breakfast of Day-4 (Table 2). The breakfast meals were found to differ non-significantly in terms of lysine content. Similarly, other indispensable amino acids namely methionine, valine, leucine, isoleucine, threonine, phenylalanine, histidine and tyrosine varied in a narrow range in breakfast of different days of the week and were found to be significantly ($p \leq 0.05$) different in most of the IAAs. The lunch served on Day-7 had higher lysine (930 mg) as compared to lunch served on other days of the week (Table 3). Lysine and valine content of the lunch meals were found to differ significantly ($p \leq 0.05$).On contrary, lysine content of dinner served on Day-3(903 mg 100 g^{-1} DM) was maximum followed by Day 7 (896 mg 100 g^{-1} DM) as shown in Table 4. The other IAAs varied in a narrow range between lunch and dinner meals of different days with most of the amino acids in a sufficient amount required for maintenance of the body.

Table 2: Protein, amino acid profile, *In vitro* protein digestibility (IVPD) and Protein digestibility-corrected amino acid score (PDCAAS)/100 g dry matter of breakfast meal of seven- days menu of hostel diets

	Days of the Week							LSD (p=0.05)	Mean
	1	2	3	4	5	6	7		
Moisture,%	67.96±0.94[a]	68.97±0.96[a]	67.32±0.94[a]	67.56±0.92[a]	59.78±0.88[b]	69.43±0.97[a]	59.44±0.95[b]	4.37	65.78±0.99
Protein, g	22.70±0.1[a]	24.34±0.14[ab]	26.53±0.23b	27.30±0.18[b]	31.27±0.21[c]	31.09±0.14[c]	35.65±0.39[d]	3.61	28.41±0.17
Lysine, mg	896±25.17[a]	930±20b	916±20.82[c]	950±34.64[d]	893±25.17[e]	896±5.77[a]	883±11.54[f]	0.04	909±8.73
Methionine, mg	853±50.33[a]	886±15.27[b]	806±35.12[c]	836±11.55d[d]	890±10[e]	816±35.12[f]	840±10g	0.05	847±7.56
Valine, mg	1756±45.09[a]	1766±15.27[b]	1890±20[c]	1826±25.17[d]	1706±15.27[e]	1800±55.67[f]	1783±5.77[g]	0.11	1790±1.43
Leucine, mg	4443±20.82	4400±20	4460±26.45	4430±17.32	4473±20.82	4443±28.86	4473±5.77	NS	4446±5.07
Isoleucine, mg	12673±55.07	12690±20	12613±35.12	12643±11.55	12670±20	12666±61.10	12670±10	NS	12660±10.82
Threonine, mg	2813±51.31	2813±15.27	2876±11.63	2816±11.54	2833±5.77	2823±25.16	2830±10	NS	2829±15.73
Phenyl Alanine, mg	2723±20.82[a]	2620±15.27[b]	2713±15.27[c]	2683±11.55[d]	2753±5.77[e]	2696±25.17[f]	2723±15.27[a]	0.06	2701±3.30
Histidine, mg	17990±81.85[a]	17930±20[b]	17906±35.12[c]	17916±23.09[d]	17916±15.27[d]	17870±10[e]	17920±10[f]	0.04	17921±10.78
Tyrosine, mg	1453±25.17	1420±26.45	1400±20	1406±28.87	1400±17.32	1433±15.27	1443±5.77	NS	1422±12.96
IVPD, %	69.82±0.53[a]	68.81±0.39[b]	68.14±0.30[c]	68.76±0.42[b]	69.92±0.05[a]	69.11±0.55[b]	69.72±0.35[a]	0.47	69.18±0.18
PDCAAS	0.48±0.01[a]	0.46±0.01[b]	0.41±0.01[c]	0.42±0.02[d]	0.35±0.01[e]	0.35±0.01[e]	0.30±0.01[f]	0.01	0.39±0.02

Values are Mean±SD of composite meals of 30 subjects, Values in columns followed by different superscripts differ significantly ($p \leq 0.05$)

The protein digestibility is dependent on internal and external factors to the protein. Internal factors include protein amino acid profile and protein folding and cross-

Table 3: Protein, amino acid profile, In vitro protein digestibility (IVPD) and Protein digestibility-corrected amino acid score (PDCAAS)/ 100 g dry matter of lunch meal of seven- days menu of hostel diets

	Days of the week							LSD (p=0.05)	Mean
	1	2	3	4	5	6	7		
Moisture,%	70.87± 0.97[a]	72.56± 0.96[ab]	68.88± 0.77[ac]	76.08± 0.89[d]	71.91± 0.94[abc]	71.66± 0.96[abc]	71.96± 0.99[abc]	3.19	71.99± 0.99
Protein, g	24.93± 0.06[a]	25.19± 0.19[a]	26.62± 0.33[ab]	23.6± 0.52[ae]	28.91± 0.29[bc]	32.45± 0.69[d]	36.75± 0.11[f]	2.89	28.35± 0.21
Lysine, mg	866± 25.17[a]	860± 10[b]	896± 11.55[c]	906± 15.27[d]	916± 15.27[e]	923± 15.27[f]	933± 49.32[g]	0.04	900± 2.18
Methionine, mg	833± 15.27[a]	810± 20[b]	903± 30.55c	806± 20.82[d]	843± 5.77[e]	860± 17.32[f]	863± 11.55[g]	0.06	845± 3.78
Valine, mg	1820± 36.05[a]	1810± 10[b]	1906± 32.14[c]	1813± 35.11[d]	1690± 10[e]	1810± 45.82[b]	1793.33± 5.77[f]	0.08	1806± 24.99
Leucine, mg	4426± 25.17	4490± 10	4500± 20	4430± 30	4510± 10	4470± 36.05	4473± 20.82	NS	4471± 13.63
Isoleucine, mg	12670± 20	12696± 15.27	12596± 25.17	12706± 15.27	12650± 17.32	12673± 5.77	12666± 15.27	NS	12665± 2.85
Threonine, mg	2783± 25.17	2803± 15.27	2716± 30.55	2830± 20	2816± 5.77	2783± 20.81	2770± 10	NS	2786± 12.15
Phenyl Alanine, mg	2676± 30.55	2713± 15.27	2673± 25.16	2706± 15.27	2773± 20.82	2676± 15.27	2713± 23.09	NS	2704± 13.27
Histidine, mg	17843± 45.09[a]	17853± 35.11[b]	17916± 15.27[c]	17900± 30[d]	17896± 5.77[e]	17863± 11.54[f]	17906± 15.27[g]	0.03	17882± 11.69
Tyrosine, mg	1456± 30.55	1443± 25.17	1430± 20	1426± 25.17	1446± 5.77	1493± 23.09	1460± 10	NS	1450± 11.63
IVPD, %	80.6± 0.55[a]	79.06± 0.06[b]	83.54± 0.27[c]	85.5± 0.25[d]	82.33± 0.20[ce]	80.55± 0.51[a]	81.25± 1.02[a]	1.23	81.84± 0.29
PDCAAS	0.49± 0.01[a]	0.47.00[a]	0.49± 0.01[a]	0.58± 0.01[b]	0.46± 0.01[a]	0.4± 0.01[a]	0.36± 0.02[a]	0.14	0.46± 0.01

Values are Mean±SD of composite meals of 30 subjects; Values in columns followed by different superscripts differ significantly (p≤0.05)

linking while external factors include pH, temperature and ionic strength conditions, the presence of secondary molecules such as emulsifiers and anti-nutritional factors. The food processing also has a substantial effect on these factors and hence, protein digestibility. In addition, both internal and external factors can also be influenced by growing conditions (e.g., drought and heat stress) during plant development (Joye 2019). The breakfast served to the young women had low protein digestibility varying between 68.14 to 69.92% with a mean digestibility of 69.18%. In comparison to the breakfast, the lunch served to the subjects had higher digestibility ranging from 79.06 to 85.5%, respectively with maximum digestibility of protein on Day-4 (85.5%). On the other hand, the digestibility of dinner meals varied between 70.64 to 74.74% with mean digestibility of 72.74% and maximum digestibility on Day-7 (74.74%). Lunch meals served on different days of the week had higher digestibility followed by dinner and breakfast meals, respectively. The food items like curd, *lassi,* etc. served in lunch meals have better digestibility as Rutherfurd and Moughan (2005) determined reactive lysine contents, true ileal reactive lysine digestibility, and true ileal digestible reactive lysine in a wide range of processed milk products. The true ileal reactive lysine digestibility was high (>91%) in all the milk products tested and concluded that milk proteins are highly digestible source of protein.

The Protein Digestibility-Corrected Amino Acid Score (PDCAAS) has been adopted by FAO/WHO as the preferred method for the measurement of the protein value in human nutrition. The method is based on comparison of the concentration of the first limiting essential amino acid

Table 4: Protein, amino acid profile, In vitro protein digestibility (IVPD) and Protein digestibility-corrected amino acid score (PDCAAS)/100 g dry matter of dinner meal of seven- days menu of hostel diets

	Days of the Week							LSD (p=0.05)	Mean
	1	2	3	4	5	6	7		
Moisture, %	75.36± 0.98[a]	72.97± 0.99[ab]	69.52± 0.87[b]	69.14± 0.99[b]	67.94± 0.97[b]	65.52± 1.0[b]	68.18± 0.99[b]	5.49	69.80± 0.99
Protein, g	26.85± 0.06[a]	25.68± 0.28[ab]	23.75± 0.26[b]	29.86± 0.15[c]	30.99± 0.12[cd]	33.35± 0.67[e]	36.38± 0.80[f]	2.21	29.55± 0.29
Lysine, mg	866± 15.27	876± 30.55	903± 15.27	873± 15.27	870± 10	886± 5.77	896± 5.77	NS	881± 2.97
Methionine, mg	833± 20.82	870± 20	810± 20	89620.82	886± 5.77	860± 10	846.67± 5.77	NS	857± 3.30
Valine, mg	1773± 20.82[a]	1890± 20b	1813± 25.17[c]	1723± 5.77[d]	1766± 15.27[e]	1850± 20[f]	1813± 15.27[g]	0.05	1804± 6.23
Leucine, mg	4446± 20.81	446635.12	4436± 30.55	4480± 10	4463± 20.82	4403± 15.27	4463± 25.17	NS	44519.37
Isoleucine, mg	12713± 25.17	12683± 30.55	12620± 30	12690± 10	12676± 15.27	12656± 20.82	12666± 20.81	NS	12672± 8.61
Threonine, mg	2790± 20	2813± 15.27	2816± 32.14	2813± 15.27	2806± 5.77	2773± 15.27	2803± 15.27	NS	2802± 2.18
Phenyl Alanine, mg	2700± 20	2650± 20	2730± 20	2740± 10	2756± 15.27	2693± 5.77	2713± 20.81	NS	2711± 3.30
Histidine, mg	18013± 15.27[a]	17850± 26.46[b]	17866± 35.12[c]	17933± 15.27[d]	17880± 10[e]	17903± 5.77[f]	17886± 11.55[g]	0.08	17904± 2.97
Tyrosine, mg	1470± 20	1443± 15.27	1410± 30	1430± 30	1430± 10	1443± 5.77	1443± 15.27	NS	1438± 10.78
IVPD, %	70.64± 0.56[a]	71.9± 0.32[ac]	74.66± 0.77[bd]	71.09± 0.68[a]	73.46± 0.01[bc]	72.67± 0.41[c]	74.74± 6.14[b]	1.37	72.74± 0.99
PDCAAS	0.40± 0.00[a]	0.43± 0.02[a]	0.50± 0.02[ab]	0.37± 0.01[a]	0.36± 0.00[a]	0.34± 0.01[a]	0.32± 0.03[a]	0.12	0.39± 0.01

Values are Mean±SD of composite meals of 30 subjects Values in columns followed by different superscripts differ significantly (p≤0.05)

in the test protein with the concentration of that amino acid in a reference (scoring) pattern. This scoring pattern is derived from the essential amino acid requirements of the preschool-age child. The chemical score obtained in this way is corrected for true fecal digestibility of the test protein. PDCAAS values higher than 100% are not accepted as such but are truncated to 100% or 1 (Schaafsma, 2000).

Considering lysine as the limiting amino acid, the PDCAAS value of the breakfast meals was calculated and it ranged from 0.30 to 0.48. The lunch served to young women had higher PDCAAS; the range was 0.47 to 0.58, respectively with maximum PDCAAS for the lunch of Day-4. Similarly, PDCAAS of dinner meals ranged from 0.32 to 0.50 with a mean value of 0.39.. The low PDCAAS values for breakfast, lunch and dinner indicates the poor quality of protein with low amino acid content and low digestibility of the diets which highlights the poor quality of protein of the analyzed meals.

The diets served on different days were found to be low in protein and lysine in all the meals served during breakfast, lunch and dinner. Diets in India are lacking in lysine due to more consumption of cereals by the population as reported by Gilani et al. (2005). Lower protein quality and quantity leads to lower protein digestibility. The food processing methods used also has a significant effect on protein digestibility. These factors affect the protein digestibility (57–75%) and it is very low when compared with protein-based foods of North America i.e. 88–94

The low PDCAAS values for breakfast, lunch and dinner indicates the poor quality of protein with low amino acid content and low digestibility of the diets which highlights the poor quality of protein of the analyzed meals. The data on nutrient analysis obtained in the present study revealed that the foods served to young adult women in the hostel mess in different meals in seven days of the week vary widely in terms of protein quality. The three meals served on Day-7 were significantly better in terms of protein and lysine content along with better digestibility and PDCAAS values which is attributed to the menu of that day.

3.1. Comparison of protein quality of three major meals

A comparison of protein quality of three major meals of hostel diets have been shown in Table 5. The average meal size was biggest for lunch (127.42 g) followed by dinner (103.21 g) and breakfast (101.2 g).

The crude protein content was maximum in lunch (10.18 g) followed by breakfast and dinner. The total protein content of the foods consumed by the subjects in three major meals was 29.49 g. The average lysine content of breakfast, lunch and dinner was 315.9, 321.7 and 274.5 mg, respectively with a total lysine content of 912.1 mg. Similarly, all other IAA content varied in very narrow range between three meals of the day. A significant (p≤0.05) difference in the IAA content of three meals has been found. The lysine/g protein content of the three meals namely breakfast, lunch and dinner were 31.3, 31.6 and 29.7 mg g^{-1} protein with a total value of 30.92 mg g^{-1} protein for three meals of a day. The meals consumed in lunch had maximum *in vitro* protein digestibility (81.88%) followed by the meals consumed at dinner and breakfast. The overall digestibility of the three major meals in the hostel diets of young adult women was 74.58%. The lunch meal had maximum PDCAAS value i.e. 0.46 while dinner and breakfast had similar PDCAAS of 0.39.

Table 5: Protein, amino acid profile, In vitro protein digestibility (IVPD) and Protein digestibility-corrected amino acid score (PDCAAS) of three major meals consumed by the young women

	Breakfast	Lunch	Dinner	LSD at 5%	Total	RDA
Meal size, g	101.2±4.74[a]	127.42±10.56[b]	103.21±5.70[c]	1.87	331.86±14.63	-
Moisture, %	65.77±4.28[a]	71.99±2.16[a]	69.80±3.31[a]	21.15	NS	-
Protein, g	10.05±3.17	10.18±2.34	9.25±2.05	NS	29.49±6.71	551
Lysine, mg	315±49.08[a] (31.34)	321±36.64[a] (31.60)	274±27.90[b] (29.67)	32.44	912±81 (30.92)	452
Methionine, mg	295±56.41[a] (29.43)	301±37.00[a] (29.62)	266±28.40[b] (28.85)	22.18	864±82 (29.30)	163
Valine, mg	622±97.51[a] (61.93)	644 ±67.82[ab] (63.29)	560±55.69[a] (60.56)	63.19	1826±139 (61.95)	392
Leucine, mg	1547±274.26[a] (153.97)	1595±170.75[a] (156.70)	1382±127.21[b] (149.43)	137.68	4524±409 (153.44)	592
Isoleucine, mg	4405±762.05[a] (438.36)	4518±480.26[a] (443.87)	3938±371.96[b] (425.81)	321.72	12862±1127 (436.18)	302
Threonine, mg	984±171.17[a] (97.95)	993±104.07[a] (97.59)	870±79.83[b] (94.10)	74.56	2848±252 (96.59)	232
Phenyl Alanine, mg	940±172.61[a] (93.62)	964±103.74[a] (94.77)	842±83.66[b] (91.13)	61.44	2748±266.41 (93.20)	382
Tyrosine, mg	493±84.51[a] (49.15)	518±60.25[a] (50.91)	446±41.41[b] (48.27)	45.17	1458±132.71 (49.46)	-
IVPD,%	69.18±0.67[a]	81.88±2.15[b]	72.74±1.63[c]	1.04	74.58±5.67	-
PDCAAS	0.39±0.06[a]	0.46±0.07[b]	0.39±0.11[a]	0.04	0.42±0.07	-

Values are Mean±SD of composite meals of 30 subjects; Figures in parentheses representamino acid as mg per g of protein; Anonymous (2010), 2 mg per gram of protein (Anonymous 2013), 3 mg per gram of protein (Anonymous, 2007),Values in columns followed by different superscripts differ significantly (p≤0.05)

On comparing the protein quality of three major meals, the total protein content of the foods eaten by the selected women was 29.49 g. which was 53.62% of the recommended dietary allowance of 55 g given by Anonymous (2010). The lysine/g of protein content of the meals consumed by young adult women was 68.72% of the recommended value of 45 mg g^{-1} protein given by Anonymous (2013). On comparing the IAAs on per gram protein basis, against the recommended dietary allowances of Anonymous (2007) and Anonymous (2013), it was observed that all other IAAs were adequate in all the meals of the present population except lysine with percent adequacy more than 100%.

The higher protein digestibility was found in lunch followed by dinner meal which may be attributed to consumption of more milk and its products like curd and *lassi* during lunch and curd in dinner. Gilani et al. (2012) reported that protein digestibility of diets in developing countries varies from 54 and 78%, while it is 90% in developed countries. Rutherfurd et al. (2012) reported that true ileal amino acid digestibility of foods commonly consumed in India varied widely. Minocha et al. (2017) reported that 4–26% population in India is at risk of quality protein deficiency.

The PDCAAS values observed for all meals in the present study are much lower when compared with the reference foods like milk and egg having a PDCAAS value of 1.0.Anonymous(1991) reported a PDCAAS value of 0.40, 0.52,0.53, 0.57 and 0.68 for whole wheat, peanut meal, rice, rolled oats and kidney beans, respectively. Ghosh (2013) reported that the PDCAAS value of foods consumed in Kenya was lower (0.58) than PDCAAS of the foods consumed in Bangladesh (0.72).

4. CONCLUSION

The diets consumed by young adult women were inadequate in lysine. In spite of the fact that other IAAs in the diets of the subjects were adequate, these cannot be utilized by the body for protein and muscle mass synthesis. The quality protein deficiency in youth can adversely affect the health leading to a rise in different types of diseases at later age. There is a to create awareness to consume adequate amounts of lysine rich foods like dairy products and or egg.

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